



Editorial

SCIENTIFIC PUBLICATIONS OF THE BalticSTE INTERNATIONAL SYMPOSIA: TRENDS AND SHIFTS IN SCIENCE AND TECHNOLOGY EDUCATION THEMES (2015–2023)

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BalticSTE (Baltic Science and Technology Education) is an international scientific event dedicated to the issues of *Science & Technology Education* (STE) in the Baltic states and beyond. The first international symposium took place in 2015. It can be reasonably said that the ideological platform of this symposium was the national scientific practical conference “Science education in general education school”, organised every year since 1995. Five international symposia took place from 2015 to 2023. It is obvious that these symposia brought together researchers, scientists, educators, policymakers, and other persons interested in science and education technology from various countries and institutions.

Natural Science and Technology Education (NSTE) promotes critical thinking, creativity, and problem-solving skills that are necessary for the 21st century job market. Productive discussions about best practices and the latest technologies help modernise education and adapt it to the rapidly changing world reality. BalticSTE symposia provide opportunities for the Baltic countries and foreign partners to exchange experiences, design joint educational solutions, and strengthen the scientific potential of the region.

In recent years, both in Lithuania and in other countries, much attention has been paid to the development of natural sciences and technologies. The declining interest of young people in natural sciences and/or technologies is of great concern (Lamanauskas, 2015). Thus, one of the main goals is to strengthen natural sciences and technology education. It must be said that the state of NSTE in Lithuania in the period from 2015 to 2025 experienced significant changes related to the improvement of educational policy, infrastructure, and teaching methods. Undoubtedly, during this period, this area has improved significantly, both in terms of infrastructure and methodology. Although natural sciences education in Lithuania has made significant progress over the past 10 years (technologies, international projects, STEM centres), structural problems remain (shortage of natural sciences teachers, low student motivation, etc.).

So, as already mentioned, five international BalticSTE symposia took place. During them, a lot of scientific, methodological, practical reports of various kinds were made, practical work and seminars were organised. Of course, scientific articles were published. A total of 150 articles were published (Table 1).



Table 1*BalticSTE Symposium Publications*

Year	Number of publications	Number of countries	Number of authors
2015	33	12	68
2017	34	16	65
2019	44	21	93
2021	16	13	27
2023	23	13	43

All publications are open access; they can be found on the symposium website, as well as in the databases CEEOL, ERIC, Scribd, DOI, Crossref, Internet Archive, Google Scholar, etc.

An analysis of the published articles was carried out according to the most important thematic areas. In total, the articles are divided into seven thematic/subject areas. Although this division is partly conditional, certain trends can be discerned (Table 2).

Table 2*Distribution of Published Symposium Articles by Thematic Areas [N (%)]*

Area / Subject	2015	2017	2019	2021	2023	Total
Chemistry Education	10	8	8	3	6	35 (23.3)
Physics Education	2	5	6	3	2	18 (12)
Biology Education	0	3	3	1	1	8 (5.3)
Ecology and Environmental Education	0	4	2	0	4	10 (6.7)
Educational Technology	7	2	7	3	3	22 (14.7)
STEM Education	0	0	2	2	0	4 (2.6)
General articles	14	12	16	4	7	53 (35.4)
Total	33	34	44	16	23	150 (100.0)

As can be seen in Table 2, the largest proportion of articles was of a general nature (35.4%), in which common natural sciences and technology education topics, trends, and methodological questions were analysed. The second largest group of articles was devoted to chemistry education (23.3%). This shows that a significant portion of scientific research is devoted to the issues of chemistry education. Articles on educational technologies account for 14.7%, reflecting the growing integration of technologies into the learning process. Articles on physics education account for 12%, biology – 5.3%, ecology and environmental protection – 6.7%. The least attention was paid to STEM (integrated science, technology, engineering and mathematics education) (2.6%). This may indicate a less developed direction of research on STEM topics or the need for its integration in the future.

General trends show that most attention is paid to general issues of natural science and technology education, but there is also a clear orientation towards specific disciplines (especially chemistry), as well as towards the growing role of technology in the educational process.

After analysing the presented list of 150 symposium articles, it is possible to distinguish several main thematic directions and their change from 2015 to 2023. Of course, such a division is rather conditional, but in any case, it allows us to discern certain aspects of thematic changes. When it comes to publications in 2015,

it can be seen (Lamanauskas et al., 2015) that attention is focused on general topics of natural science and technology education, such as the effectiveness of educational methods, educational competencies, students' interest in natural sciences and mathematics. The issues of chemistry teaching are relatively actively analysed, emphasising educational strategies (e.g., critical thinking, interdisciplinary integration, etc.). It can also be argued that the use of educational technologies is expressed as an important trend, with a relatively large number of articles on the application of information communication technologies in the classroom.

There are 34 articles published in the 2017 symposium publication (Lamanauskas, 2017). It can be noted that there is a stronger focus on interdisciplinary topics and environmental education. Undoubtedly, a more intensive analysis of physics teaching and ecological education topics is noted. Teacher professional development and the application of active learning strategies (for example, inquiry-based learning (IBSE), problem solving, conscious learning) have become much more significant topics (research areas).

The largest number of articles, as many as 44, were published in the publication of the fourth symposium held in 2019 (Lamanauskas, 2019). It is undoubtedly noticeable that the attention to educational technologies and digital tools in the educational process has increased significantly. Student assessment and self-assessment strategies, as well as formal assessment, have become much more prominent. The integration of the STEM direction is clearly noticeable, although there are few articles, but for the first time, it clearly stands out as a separate area. It should be noted that there is a clearer focus on teachers' pedagogical knowledge and competencies, especially in the context of physics and chemistry teacher training.

In 2021, the symposium was held remotely (Lamanauskas, 2021). This situation arose due to the prevailing COVID-19 pandemic. This is also reflected in the number of articles prepared for publication. Only 16 were published that year. Despite the noticeably smaller number of articles (possibly due to the influence of the pandemic), there is a clear focus on the teacher and students' ability development, taking into account the 21st century competencies. Particular emphasis is placed on digital education, digital competencies, distance and integrated teaching/learning. Students' cognitive abilities and the development of scientific thinking have begun to be assessed and analysed more.

The fifth international BalticSTE2023 symposium took place after the pandemic period, in 2023. (Lamanauskas, 2023). Analysing the published articles, it can be seen that the integration of modern technologies is emphasised (e.g., 3D holograms, chatbots, IoT (Internet of Things), interactive content, etc.). The topics of the publications (and, of course, the research conducted) are clearly oriented towards developing practical skills, solving ecological issues, and raising public awareness (e.g., biodegradability, environment preservation, etc.). There is also a greater focus on inclusive education, teaching students with special needs, and teaching differentiation.

It is not very reliable to talk about certain trends or directions of this period on the basis of publications, but some directions can be discerned. One could probably talk about certain insights, observations, rather than very clear directions. However, this helps to understand the general problematic of educational research in the field of NSTE more clearly. For example, by reviewing the publications from 2015 to 2023, the direction of technological breakthroughs and digitalisation is observed. If in 2015 there were only individual publications on educational technologies, then later it became practically one of the most important research directions. One cannot fail to notice a rather clear trend – this is technology integration into education, starting from simple computer programs and moving on to complex interactive technologies, such as 3D holograms, IoT, virtual or augmented reality tools. Also, increasing attention is paid to interdisciplinary interfaces (especially chemistry and mathematics, chemistry and biology), the development of problem-solving skills, and integrated STEM / STEAM directions. As researchers rightly note, it is increasingly recognised that STEM knowledge is a priority in the development of education (Cedere et al., 2020). In addition, access to STEM enables students to become more creative thinkers and problem solvers, with the necessary abilities and skills to solve everyday problems and issues in new and innovative ways (Siew, 2017). Another noticeable direction is ecology and sustainable development. Growing attention to ecological education and environmental awareness is observed especially in works published in 2017 and 2023.

Another noticeable direction is associated with the development of students' cognition and competence. Intensive attention is paid to the development of students' cognitive abilities (metacognition, scientific thinking, research skills, etc.). The need to develop 21st-century skills (critical thinking, creativity, the ability to solve



complex problems, etc.) is particularly evident. For example, research results show that students with higher cognitive needs often have better academic performance and greater willingness to engage in cognitively demanding activities (Popoviciu et al., 2011).

Another significant trend is also noticeable, which is associated with the evolution of educational methods and techniques. It can be conditionally stated that there is a transition from conventional educational methods to research-based, interactive, problem-based teaching and formative assessment methodologies. In turn, the development of teachers' pedagogical knowledge and competencies is becoming an integral part of scientific and practical research. Researchers note that the goal of teacher education is to prepare a teacher able to master teaching innovations and acquire professionally valuable competencies (Kobalia & Garakanidze, 2010). Promoting an independent learning environment, using everyday contexts and situations, raising challenges for students through open activities, and promoting epistemic practices (e.g., focusing attention, describing, communicating, and reasoning) are significant teacher competencies (Pinto et al., 2014).

After analysing the scientific publications of the 2015–2023 BalticSTE international symposia, it can be stated that the change in the topics of natural science and technological education reflects both global trends in educational development and specific regional needs and challenges. Several important directions have noticeably emerged: the strengthening role of technologies and digitalisation in education, increasing attention to an interdisciplinary and integrated STEM approach, the application of active and innovative teaching methods, and a significant emphasis on ecological and sustainable development. In addition, there is a growing attention to the teachers' professional development, strengthening of their pedagogical competencies, especially focusing on the ability to apply modern technologies, and interactive teaching (learning) strategies. Although the division of thematic areas is partly conditional, it allows us to clearly see the trends and changes over the past years. A clear necessity is seen to further develop STEM education, promote students' motivation and interest in natural sciences and technologies, and strengthen students' skills, necessary in the 21st century. BalticSTE international symposia, held from 2015 to 2023, are undoubtedly an important platform for scientific research and discussions on natural science and technology education.

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